

Design of a zeolite-encapsulated silver based wound dressing and comparisons with commercial dressings in an *in vitro* colony biofilm assay



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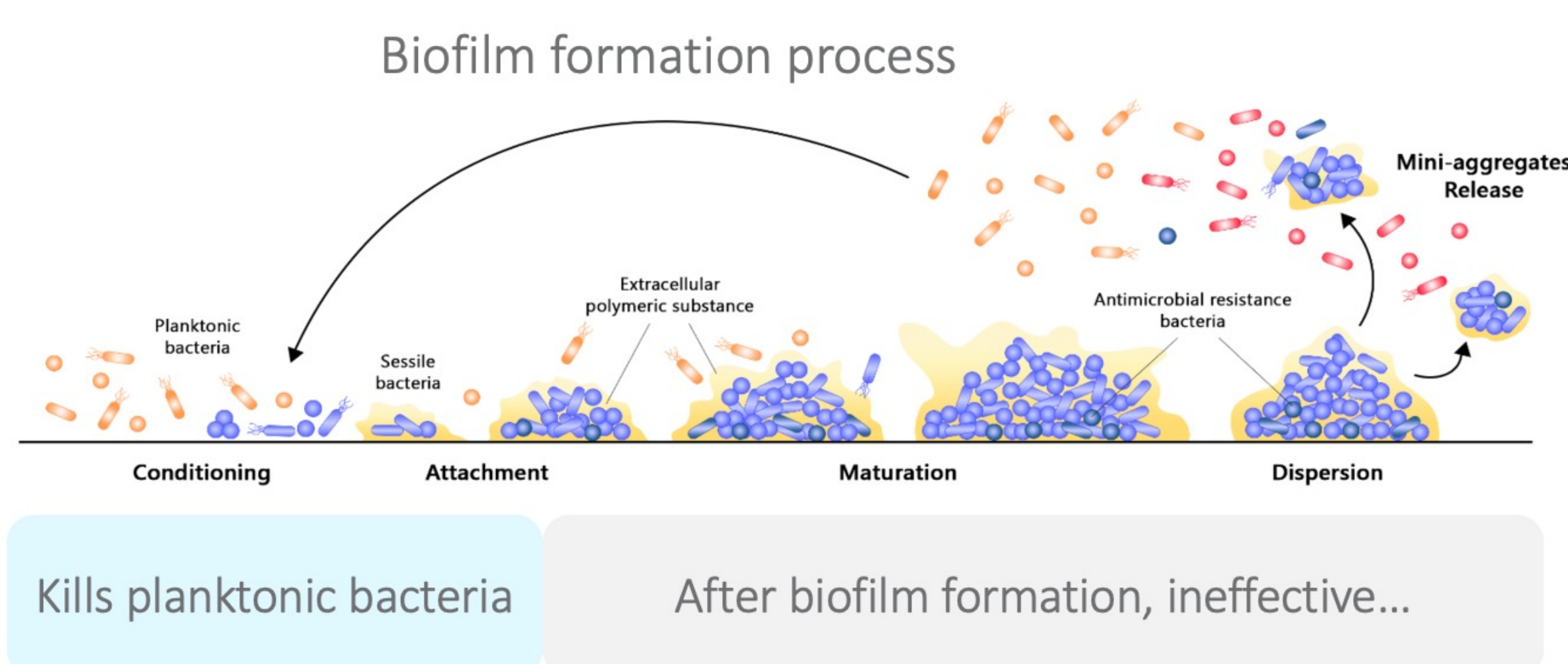
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- At ZeoVation, a silver based wound dressing was prepared by deposition of silver-zinc ion-exchanged nanozeolites along with benzalkonium chloride on a commercially available ECM matrix.
- These dressings and the commercial dressings were tested on top of a SWF (simulated wound fluid) layer on a 48-hour PA01 biofilm grown on a cellulose membrane resting on a nutrient-loaded agar gel. After well-defined periods of time (1-7 days), the bacteria on the dressing and the cellulose membrane were extracted and the bacterial colonies counted.
- ZeoVation dressing performed significantly better ($p < 0.05$) than the commercial dressings in reducing the bacterial load of the biofilms. For days 1-4, there was no bacteria detected on the nanozeolite dressing or the cellulose membrane. The four commercial membranes all had residual bacteria on the dressing and the membrane.
- *In-vivo* wound treatment study on pigs is in progress.

The Problem: Non-Infected Healing of Chronic Wounds

- Chronic wounds affect 6.5 million patients in the US yielding healthcare costs of \$25 billion per year.^{1,2} In developed countries, 1 to 2% of the population will experience a chronic wound at some point in their life.^{2,3}
- Biofilm is a common infection of wounds. Aggregates of bacteria can secrete extracellular polymeric substances (EPS) to form a film that protects the bacteria. These biofilms protect the bacteria from the patient's immune system and antibiotic treatments. It is estimated that 60% of chronic wound infections have bacterial biofilms.⁴
- Market size: The global anti-biofilm wound dressing market was \$714.7 million in 2022 and is expected to expand at a compound annual growth rate (CAGR) of 9.6% from 2023 to 2030. The increasing incidence of chronic diseases such as diabetes, cancer, and other autoimmune diseases is anticipated to increase the incidence rate of chronic and acute wounds across the globe.

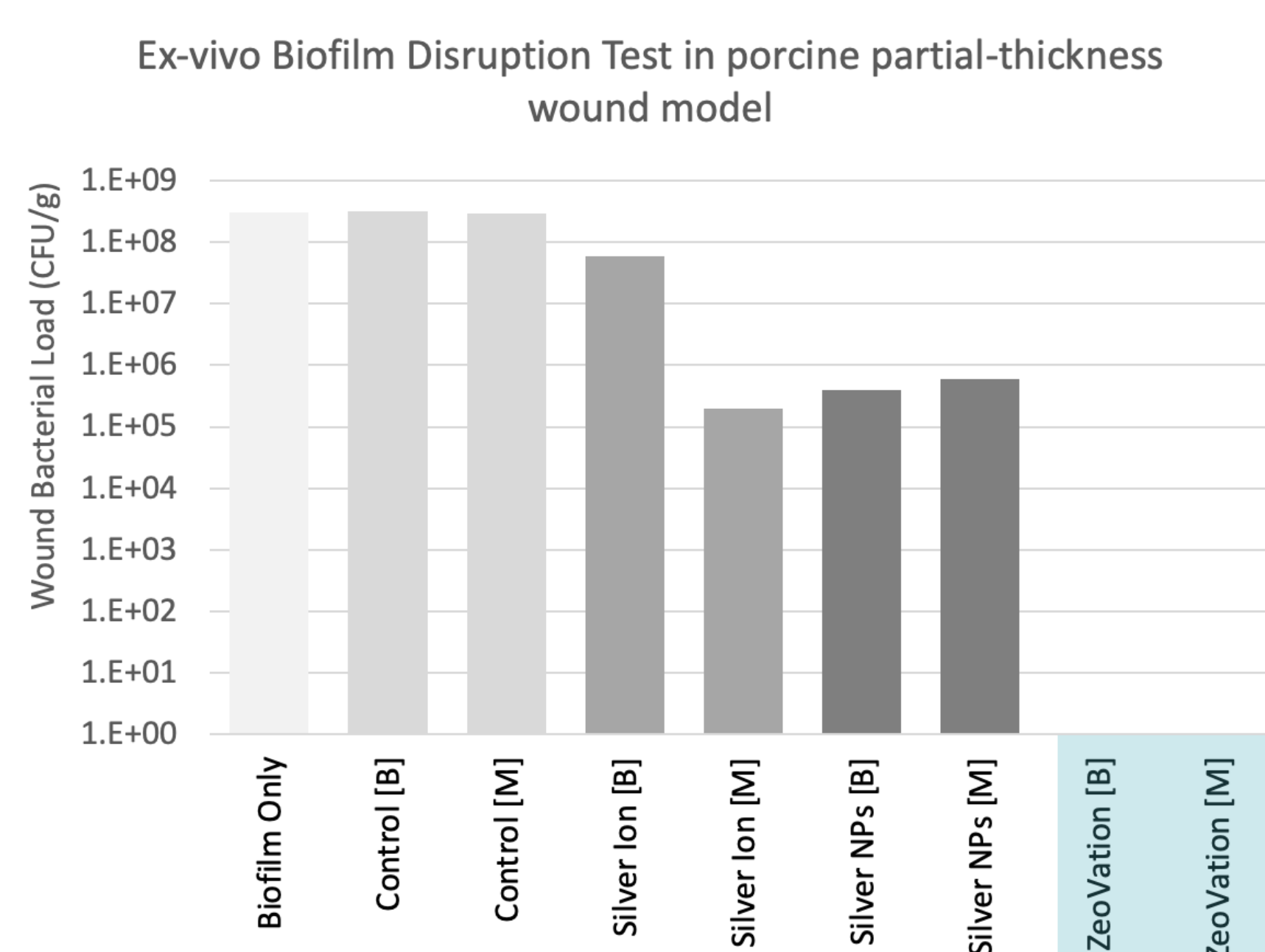


Current Solution: 4-Step Process

- Current clinical treatment includes cleansing, debridement, refashion and dressing.
- The debridement step requires professional execution technique, disrupts the wound healing process and creates pain to the patients.
- So, in the US, wound infection treatment occurs in wound care clinics by specialty nurses.
- A simple, non-disruptive, affordable and painless solution to treat biofilm infection and accelerate wound healing is in high demand.

ZeoVation Solution

- A balance between biofilm disruption/inhibition and wound healing process, including cytotoxicity, inflammation, granulation and epithelization;
- Promoting biofilm-infected wound healing via controlled release of the active silver;
- Supporting the innovative active ingredients on a biologic extracellular matrix (ECM) to transit from an inflamed, stalled state to a remodeled, healed wound with lower scarring.



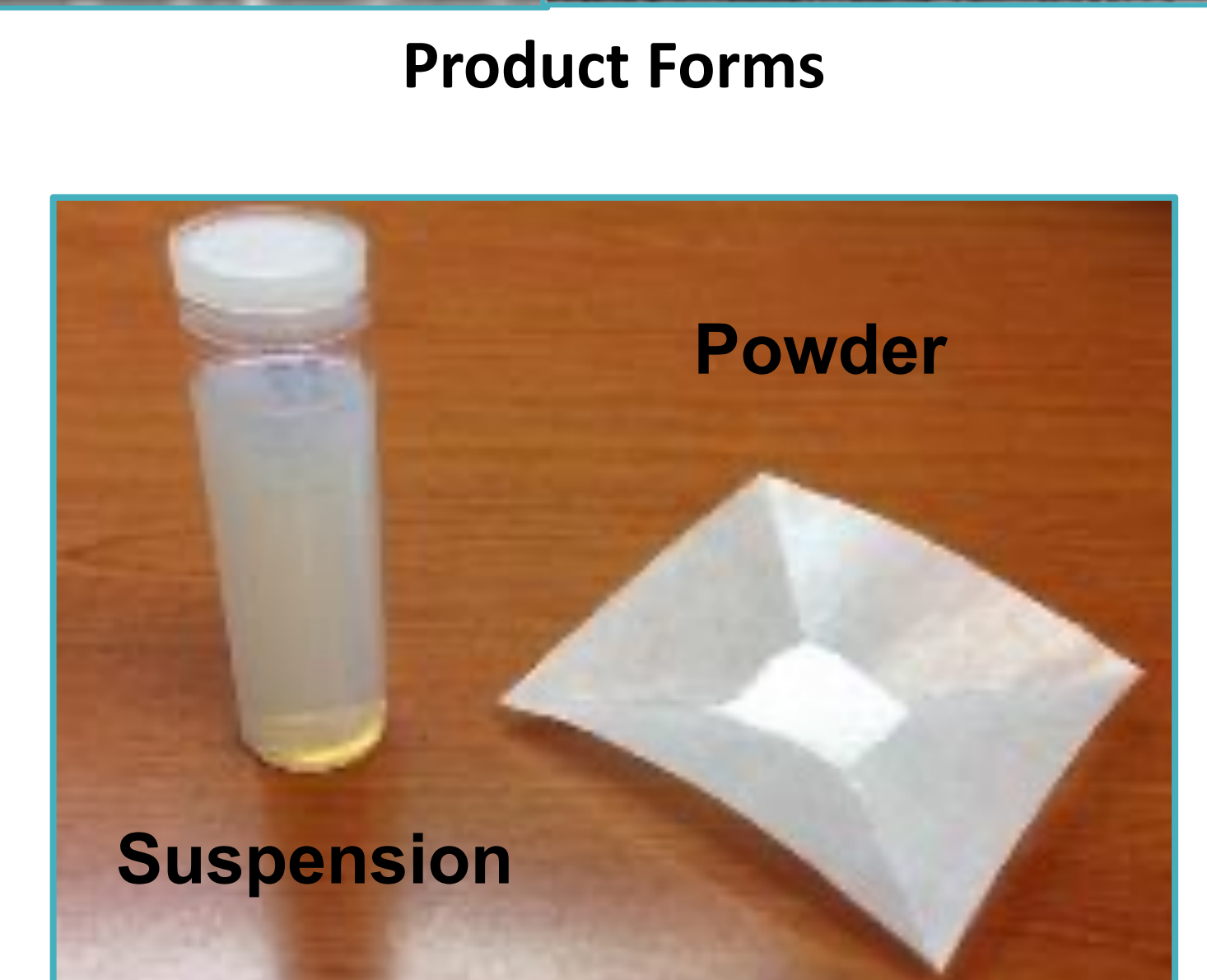
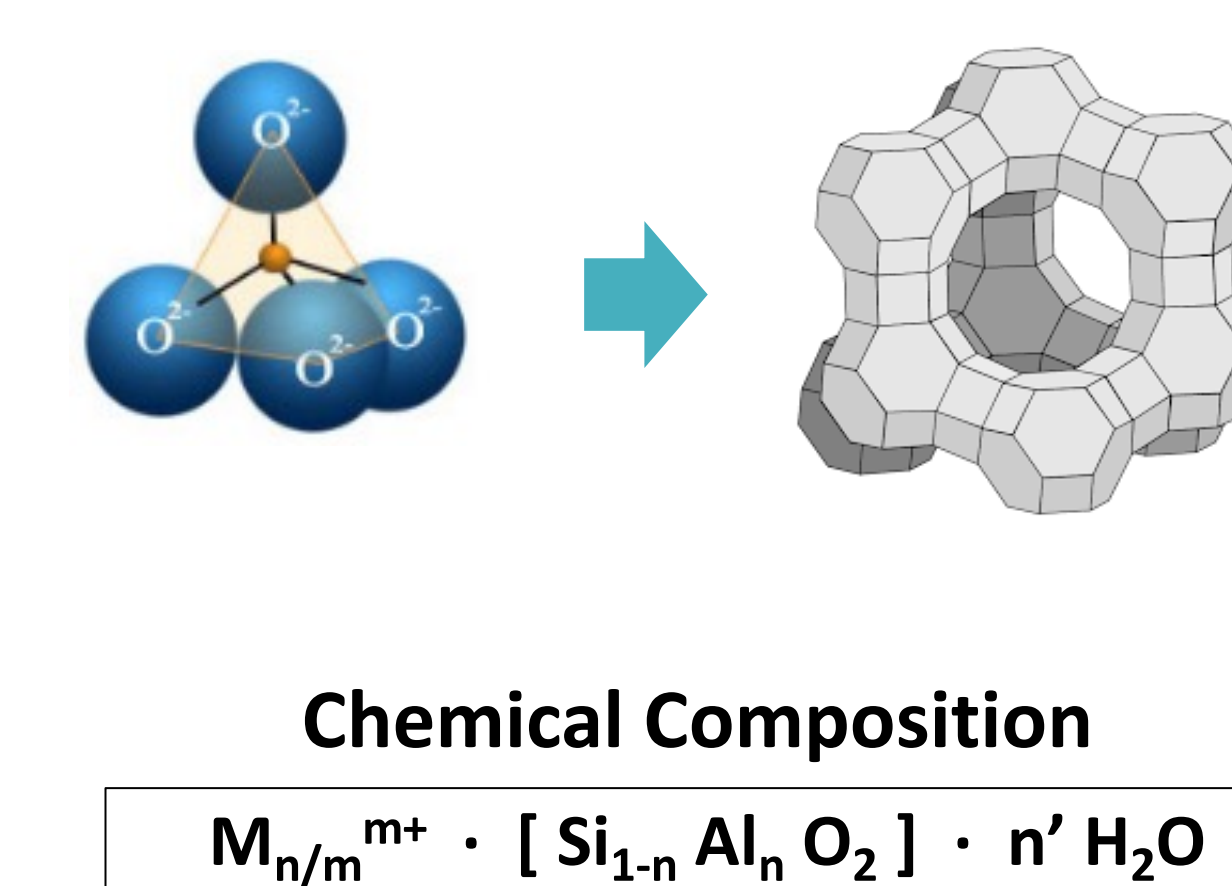
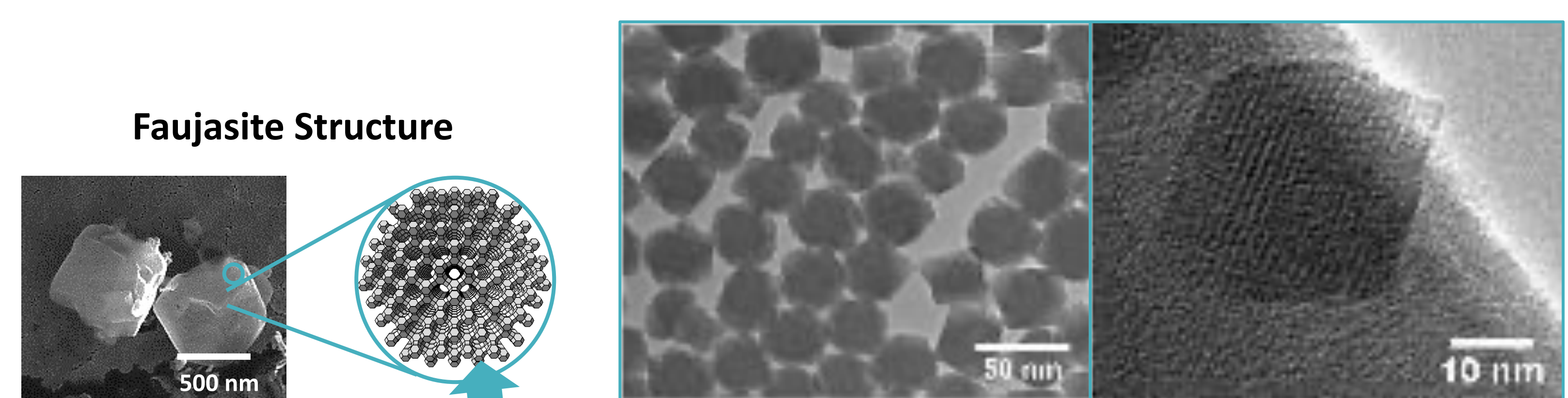
In vitro Test Results

- Preliminary studies show that with *Pseudomonas aeruginosa* (PA01) mature biofilms, the bacteria on both the biofilm (M) and on the wound dressing (B) shows >8 log decrease within 24 hours for the ZeoVation product and significantly better than a silver ion or silver nanoparticle dressing (all three similar concentrations of silver).
- ZeoVation has received a R&D contract from the Air Force to validate this technology in animal models by comparing to leading commercial silver-based wound dressings Acticoat, Procellera, Promogram and Aquacel Ag.

Nanozeolite - The platform material

- Zeolites are crystalline aluminosilicates with a very well defined and regular pore structure. Of interest to the present poster is the faujasite zeolite, which has a tetrahedral arrangement of 13 Å supercages connected through four 7.4 Å windows.
- The aluminosilicate framework is negatively charged, thus requiring charge-balancing cations. These cations can be ion-exchanged with other ions.
- Nanozeolite has the features of:
 - Stable Non-Aggregated Suspension;
 - Large External Surface Area;
 - Short Diffusion Path.
- **Core IP: High yield and rapid synthesis method:** from 5% in 7 days to 91% in 29 hours;
- First and only commercially viable manufacturing method of 30 nm zeolite nanoparticles;
- Manufacturing:
 - Internal: 1 kg per month; plan 5 kg per month.
 - External: Seeking partners.
- By encapsulating different molecules/ions in nanozeolite pores, nanozeolite serves as platform materials which can be functionalized for various applications.
- We have taken advantage of the ion-exchange and introducing molecules in the intra-zeolitic space to create consumer products, including the wound dressing product.

Electron Microscopy of Nanozeolite Particles



We are prepared to send samples for testing and are seeking long-term strategic partnerships to commercialize this product.

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